REMARKS

Claims 1-36 are now pending in the application. By this paper, Claims 1 and 16 have been amended and Claims 33-36 have been added. The basis for these amendments and new claims can be found throughout the specification, claims, and drawings originally filed. No new matter has been added. The preceding amendments and the following remarks are believed to be fully responsive to the outstanding Office Action and are believed to place the application in condition for allowance. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

Claims 1-3, 5, 8, 16-18, 20, 22, and 23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kubo (U.S. Pat. No. 6,257,688) in view of Ishizaki (U.S. Pat. No. 6,454,377).

Claims 4 and 19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kubo (U.S. Pat. No. 6,257,688) in view of Ishizaki (U.S. Pat. No. 6,454,377), as applied to Claims 1 and 16 above, and further in view of Tajika (U.S. Pat. No. 5,861,895).

Claims 6 and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kubo (U.S. Pat. No. 6,257,688) in view of Ishizaki (U.S. Pat. No. 6,454,377), as applied to Claims 1 and 16 above, and further in view of Nozawa (U.S. Pat. No. 6,499,812).

Claim 7 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Kubo (U.S. Pat. No. 6,257,688) in view of Ishizaki (U.S. Pat. No. 6,454,377), as applied to Claims 1 above, and further in view of Mikami (U.S. Pat. No. 4,633,269).

Claims 9, 11-13, 24 and 26-28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kubo (U.S. Pat. No. 6,257,688) in view of Ishizaki (U.S. Pat. No. 6,454,377), as applied to Claims 1 and 16 above, and further in view of Usui et al. (U.S. Pat. No. 6,981,761).

Claims 10 and 25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kubo (U.S. Pat. No. 6,257,688) in view of Ishizaki (U.S. Pat. No. 6,454,377), as applied to Claims 1 and 16 above, and further in view of Shinoura et al. (U.S. Pat. No. 6,714,173).

Claims 31 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kubo (U.S. Pat. No. 6,257,688) in view of Ishizaki (U.S. Pat. No. 6,454,377), as applied to Claims 1 and 16 above, and further in view of Ishizaki. (U.S. Pat. No. 6,454,377).

These rejections are respectfully traversed.

Independent Claim 1 recites a droplet discharging apparatus including a means for discharging a discharge liquid in the form of droplets through an aperture by mechanically deforming a piezoelectric element by a normal drive signal, a drive integrated circuit disposed adjacent to and in thermal contact with the piezoelectric element, and a substrate attached to and in thermal contact with the piezoelectric element and the drive integrated circuit. A diaphragm is disposed adjacent to and in thermal contact with the piezoelectric element and a temperature sensor is associated

with the drive integrated circuit for sensing a temperature of the drive integrated circuit. The sensed temperature of the drive integrated circuit approximates a temperature of the piezoelectric element, and the sensed temperature of the drive integrated circuit approximates a temperature of the piezoelectric element. The approximated temperature of the piezoelectric element approximates a temperature of the diaphragm, which approximates a temperature of the discharge liquid. The droplets are discharged from the aperture by a cooling drive signal based on the approximated temperature of the discharge liquid, which is different from the normal drive signal.

Independent Claim 16 recites a droplet discharge method including sensing a temperature of a drive integrated circuit disposed adjacent to and in thermal contact with a piezoelectric element, approximating a temperature of the piezoelectric element based on the sensed temperature of the drive integrated circuit, and approximating a temperature of a diaphragm disposed adjacent to the piezoelectric element. A temperature of a discharge liquid disposed adjacent to the piezoelectric element is approximated based on the approximated temperature of the diaphragm and the discharge liquid is discharged in the form of droplets through an aperture by mechanically deforming the piezoelectric element. The discharge liquid is cooled by a cooling discharge based on the approximated temperature of the discharge liquid, which is different from normal discharge.

In this manner, the present teachings disclose a substrate in contact with a piezoelectric element and a drive integrated circuit, as well as a diaphragm disposed adjacent to the piezoelectric element and a discharge liquid. A temperature sensor senses a temperature of the drive integrated circuit, which approximates a temperature

of the piezoelectric element, the diaphragm, and the discharge liquid, as the drive integrated circuit is in thermal contact with the piezoelectric element via the substrate and the piezoelectric element is in thermal contact with the diaphragm, which is disposed adjacent to the discharge liquid. Therefore, the droplet discharging apparatus and method of the present teachings can approximate a temperature of the discharge liquid due to the relationship between the drive integrated circuit, the substrate, the piezoelectric element, the diaphragm, and the discharge liquid. See the specification at Page 15, Paragraph [0068] and Figure 3.

Applicants respectfully submit that the combination of Kubo and Fukano fail to teach or suggest a droplet discharging apparatus including a drive integrated circuit in thermal contact with a piezoelectric element via a substrate or a piezoelectric element disposed adjacent to a diaphragm. The combination similarly fails to disclose approximating a temperature of a discharge liquid based on a drive integrated circuit being in thermal contact with a piezoelectric element via a substrate and the piezoelectric element being in thermal contact with a diaphragm disposed adjacent to the piezoelectric element and the discharge liquid.

The Examiner admits that Kubo fails to disclose a drive integrated circuit disposed adjacent to and in thermal contact with a piezoelectric element and that a temperature sensor associated with the drive integrated circuit senses a temperature of the drive integrated circuit, which approximates a temperature of a piezoelectric element. Furthermore, the Examiner admits that Kubo fails to disclose approximating a temperature of a discharge liquid based on a temperature of a piezoelectric element and that droplets are discharged from a discharge head based on an approximated

temperature of the discharge liquid. Applicants respectfully submit that Kubo also fails to teach or suggest a diaphragm disposed adjacent to and in thermal contact with a piezoelectric element and a discharge liquid. Kubo also fails to teach or suggest a substrate in thermal contact with a drive integrated circuit and a piezoelectric element. Applicants respectfully submit that Fukano fails to cure these deficiencies on Kubo.

Fukano discloses temperature sensors (141-147) that monitor a temperature of a transmission gate (TG) that is in close proximity to piezoelectric elements (PE). See Fukano at Figure 4. The Examiner asserts that the transmission gate (TG) is associated with a head-drive circuit (130) and, therefore, the temperature sensors (141-147) are similarly associated with the head-drive circuit (130) and provide data representative of a temperature of the piezoelectric element (PE).

While Fukano discloses a relationship between temperature sensors and a transmission gate, Applicants respectfully submit that Fukano fails to teach or suggest a droplet discharging apparatus including a substrate in thermal contact with both a drive integrated circuit and a piezoelectric element or a piezoelectric element in thermal contact with a diaphragm, whereby the diaphragm is disposed generally between the piezoelectric element and a discharge liquid.

Therefore, Applicants respectfully submit that Fukano fails to teach or suggest approximating a temperature of a piezoelectric element based on a temperature of a drive integrated circuit thermally connected to the piezoelectric element by a substrate. Furthermore, Applicants respectfully submit that Fukano fails to teach or suggest approximating a temperature of a discharge liquid based on an approximated temperature of a piezoelectric element and a temperature of a diaphragm.

In light of the foregoing, Applicants respectfully submit that the combination of Kubo and Fukano fails to teach each and every element of the claimed teachings. Accordingly, Applicants respectfully submit that independent Claims 1 and 16, as well as Claims 2-15 and 17-32, respectively dependent therefrom, are in condition for allowance. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

NEW CLAIMS

New Claims 33-36 are added for consideration. Because Claims 33-36 respectively depend from independent Claims 1 and 16, which are believed to be in condition for allowance in light of the foregoing remarks, new Claims 33-36 are similarly believed to be in condition for allowance.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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